A railway already follows the lower course of the Irrawadi, between Rangoon and Prome. This route has just been extended to Tungu on the Sitang, and ultimately will proceed to Mandelay, and even to Bhamo. A branch could be made at Mandelay, and touch the Me-Kong at Kiang-Tung, though in this comparatively short space it must cross at least eight mountain chains having a height of two thousand metres. One can imagine the inclination of the sides and the depth of the valleys among mountains so near each other. The Saluen flows seven hundred metres below the hills which border it: it is therefore out of the question to consider this.

Another project is to start from Bhamo, and to reach Talifu by Man-Wyne or Momein. In this territory the hills are even more marked, more abrupt, and steeper, than in the preceding, and the population is much to be feared. Even the Brahmapootra has been suggested: it is easily ascended to Sooja, partly by rail, partly by steam; but above this the route is impracticable, there being a rapid and uninterrupted succession of high mountains and high-banked rivers.

To summarize these data, the two Chinese rivers must be abandoned, not precisely on account of the difficulties of the territory, but because for a long time the celestial empire will be more or less impenetrable and dangerous for Europeans, and the course of the Me-Kong is too long and too hilly. The routes which traverse the bed of the Brahmapootra and the valley of the Irrawadi present such obstacles that they are impracticable. The route of the Saluen is more attractive; but it must not be forgotten, that, besides its length, it must cross two watersheds, one of which at least is very difficult, and must ascend the Me-Kong for a very long distance. The route by the Red River remains, which is not at all wonderfully accessible; but, to establish communications with Yun-Nan and with Se-Chuen, some obstacles must be surmounted; and this is the course which offers fewest of them. Beside the fact that it is shortest, it will not be necessary to cross mountains or to traverse valleys. The French recently sent a commission of engineers to survey for a railway between Tonquin and Burmah. We doubt whether this project can be realized; but these investigations will necessarily bring forth important data in regard to the penetration of western China.

THE GEOLOGY OF JAPAN.

THE Japanese geological bureau has prepared a series of maps illustrative of the geology of the Japanese archipelago, to be presented at the Geological congress at Berlin this year. The bureau was established in 1879, and includes topographical, geological, and agronomical departments, and a chemical and technical laboratory officered by Germans. The area already surveyed by the topographers is about eighty geographical miles square; and the whole country is expected to be surveyed and mapped in about eight years more. The geological survey has reached about the same extent as the topographical. The maps and accompanying text are being published in both Japanese and English. The agronomical survey was begun in 1882. A map showing the knowledge at present attained, of the geological structure of Japan, is amongst the series. The observations made are summarized as follows: All the geological formations are met with in Japan. Gneiss occurs in small quantities in the neighborhood of Nagasaki and in the centre of the main island. Crystalline schists, consisting of mica, talc, marble, serpentine, etc., are found in Shikoku and the south-west of the main island. The paleozoic formations embrace the largest portion of the country, and are found everywhere. The mesozoic formation, including trias, jura, and chalk, is also known in Japan, but is not so prevalent as the previous one. Trias occurs in the north and south-west of the main island and in Shikoku. Chalk is found widely distributed in Yezo, the main island, and Shikoku. The cenozonic formation, including the tertiary and quaternary, is found everywhere on the edges of the older mountain ranges. In these formations numerous remains of mammals are found, especially of prehistoric elephants. Of the Plutonic rocks, granite is found widely distributed, and covers, next to the paleozoic formations, the widest area. The volcanic rocks consist mostly of trachyte and andesite: basalt is rare. Among the soils in Japan is the so-called tuff, i.e., volcanic tuff, which, for the most part, consists of decomposed silicates, and which is of great importance to agriculture. It is almost wholly unknown in Europe, while in Japan it forms the greater part of the so-called *hara*, which are the uncultivated plains at the foot of mountains, but which will bear cultivation. Accurate knowledge of this kind of soil will be of the utmost moment to Japanese agriculture. It is also noticeable that Japanese soils in general are very poor in chalk, and would therefore be improved by the addition of marl and chalk.

AMERICAN ENGINEERS AT DEER PARK.

THE annual convention of the American society of civil engineers, just held at Deer Park, Md., June 24–26, will be remembered as one at which more business was transacted, and more discussion elicited, than at any previous convention of the society. In fact, the limit in this direction may fairly be said to have been reached; and the thin attendance at the meetings of the last day was followed early in the afternoon by a motion, which was unanimously carried, that the reading of the remaining papers be dispensed with, as the members were too tired to listen to them. The experience at the conventions of the past few years had indicated the advisability of devoting less time than formerly to excursions and sight-seeing; and the meeting this year was therefore purposely held in a place offering little of local engineering interest, and where almost the whole time could be devoted to the business of the occasion.

The convention was attended by over one hundred

members; and the proceedings were opened on Tuesday, June 23, by the reading of a very interesting paper by Mr. E. B. Dorsey, entitled 'English and American railroads compared.' It appears that the average cost of the English railroads has been $202,227 per mile, as against $62,176 for the American roads. At six per cent, to justify this increased expenditure, that part of the operating expenses which is affected by good or bad construction should involve a saving of about $8,000 per mile per year in the case of the English roads. The comparisons of the writer showed that this was by no means the case, the saving being rarely over $1,000. Comparisons of this kind, however, cannot pretend to be more than approximations, as the items of expense cannot always be accurately separated; and, moreover, the figured cost of English roads probably includes the cost of parliamentary proceedings in obtaining the charter. Regarding the physical characteristics of the English roads, few of them attain elevations of nine hundred feet above the sea; and their construction, therefore, offered few engineering difficulties, their greater first cost having been due to the almost entire absence of temporary structures. Recently several miles had been laid with steel sleepers, weighing a hundred and twenty-four pounds, on the London and north-western railway, following the example of the German roads, where they are quite common. Of freight-cars, only about twenty per cent have brakes in England; and these are so placed that they cannot be operated when the train is in motion: so the only effective ones are those on the engine and caboose. And in passenger-trains, where the air-brakes are used, but where only one car in three or four has a hand-brake, platform-cars heavily loaded with cast-iron, and provided with powerful hand-brakes, are attached on steep grades, to hold the train in case of accident to the air-brakes.

Prof. T. Egleston of New York presented an interesting paper on the cause and prevention of the decay of building-stones. In the speaker's investigation of the decomposition of calcareous materials due to the action of city gases and rain-water, he had found that the action was a maximum at a height of ten feet above the ground, above which point it decreased, and was null above a height of a hundred feet. To prevent decay, the only remedy was to make the stone water-proof. The speaker believed that a wash of sulphur was the only thing of value, where the stone was a dolomite, according to some experience in England. In the case of all porous stones, he considered that an effectual remedy would be to immerse the stone in boiled linseed-oil, renewing the application until the stone was saturated. Some discussion on this paper took place, many members believing that the use of oil would prevent the formation of a good bond between the stones and the mortar. It was stated, however, that the method had been tried with success in England.

A valuable and extensive report was presented by the committee on the preservation of timber, whose work has covered five years. It appears from the experience in this country that Kyannizing, or treatment with corrosive sublimate, though of value when the wood is only exposed to occasional moisture, is not efficacious when the wood is permanently wet. Although the testimony obtained was somewhat conflicting, the committee recommended the process of Burnettizing (chloride of zinc) as the best process for preserving railroad ties, principally on account of the low cost, which was only from twenty to twenty-five cents a tie. Creosoting was found too expensive; although it is the only effectual method for wood exposed to the attacks of the teredo and limnoria, and is, without doubt, the most generally successful process. In connection with this report, a report was presented by Mr. F. Collingwood, on the preservation of forests.

A paper followed by Mr. Jos. M. Wilson of Philadelphia, on specifications for iron and steel railroad-bridges, which was succeeded by a long discussion regarding the cantilever bridge at Niagara Falls, on which a paper had previously been presented to the society. The specifications for this bridge, in which steel was used for all the principal compression members, provided for the use of open-hearth steel alone. In this discussion the opinion was very generally expressed that Bessemer steel should not have been barred out, and that in drawing up specifications the engineer should insist simply on a certain quality as determined by physical tests, leaving the manufacturer free in the method of manufacture. It is probable in this case, however, that Bessemer steel was excluded to prevent delays in getting steel from works that had not had experience in making steel for structural purposes, as most of the Bessemer works had been making rail steel, and not structural steel. The fact that in making the steel for this bridge a hundred and thirty-six beats out of two hundred and forty-five were rejected, showed, in the opinion of many members, that engineers were requiring too much of steel, that the specifications were too rigid, and that a softer steel should have been used.

Among the remaining papers presented, brief mention may be made of a few. Mr. J. A. Ockerson described a new apparatus for printing conventional topographical signs upon maps by means of a roller. Mr. Clemens Herschel gave a new method of determining the discharge over a submerged weir. Capt. Michaelis read a paper entitled 'Can we make heavy guns?' Professor Egleston added his testimony that there would be no difficulty in making cast-steel guns of a hundred or even a hundred and fifty tons. Mr. C. B. Brush explained the method of aerating the water supplied to Hoboken. The bad taste and disagreeable odor previously existing had been entirely remedied.

In addition to the reading of papers, some important business was transacted at the convention. There having been considerable discussion of late in regard to the proper relation to each other of the form of the head of a rail, and the flange, and tread of wheels, it was resolved that a committee of five be appointed to investigate this subject. It was also resolved to memorialize congress to appropriate the sum of ten thousand dollars to carry on tests of steel

for structural purposes, under direction of this society, at the Watertown arsenal. The most important action, however, was the passage of a resolution providing for the appointment of a committee of seven, to consider what changes in the organization of this society might be advisable in connection with local engineering societies, and with sections or chapters of this society.

WORK OF THE CHALLENGER EXPEDITION. — I. GENERAL AND PHYSICAL.

Two immense quarto volumes luxuriously printed, and crowded with maps, plates, and woodcuts, form vol. i. of the series of Challenger reports, and the official introduction to that series when it shall be complete. This publication, unlike the monographs of which the series is composed, is the work of many hands, and has been editorially supervised by Staff-commander Tizard, R.N., Prof. H. N. Moseley, Mr. J. Y. Buchanan, and Mr. John Murray.

Owing to the recall of Capt. Nares for duty with the last British arctic expedition, the death of Sir Wyville Thomson, and other unforeseen occurrences, modifications of the original plan became necessary. The result is not altogether satisfactory to the editors, as they explain in the preface. It may be surmised that official red tape had something to do with the retention of a system, or rather want of system, which certainly might have been much improved; though, for that, the gentlemen named would appear not to be responsible. Thus, instead of finding the contributions of the expedition to any one branch of science summarized, or systematically and continuously indicated, the text abruptly changes, without apparent reason, from (let us say) hydrography to narrative, or to some abstract of new organic forms in a particular group, which seldom seems connected in any intimate way with the locality being described or with the subsequent text. Occasionally we get a section of transcendental theorizing on abstruse questions, of a sort which, however proper in its place, seems to us out of place in a volume intended for the general reader. The editors were also hampered by the fact that many of the special reports were incomplete, or not in a state to be briefly summarized. The inconveniences of the construction of the book will be sufficiently obvious to every reader; but, having said this, little more remains in the way of adverse comment. That the work is a mine of wealth for the hydrographer, the biologist, and the geographer, goes without saying. Even the ethnologist will find himself well rewarded for his study of its pages. The illustrations, though of unequal merit, are, for the most part, of a high degree of excellence; and some of the woodcuts, especially of corals, are extremely beautiful. Much of the success in this direction is doubtless due to the efforts of the artist of the expedition, Dr. J. J. Wild. There is a notable absence of the cheap 'process' cuts so conspicuous in most of our own government publications.

Report on the scientific results of the voyage of H. M. S. Challenger [*etc.*]. *Narrative.* 1 vol. in two parts. London, *Government,* 1885. 4°.

It is of course impossible, within the limits of *Science*, to adequately review a work of twelve hundred quarto pages, which in itself is a summary and a synopsis. We shall endeavor to touch upon a few of its more prominent features, premising that our references must necessarily be mere samples of the harvest gathered in its pages.

The voyage of the Challenger began, for deep-sea work, off the coast of Spain; thence, *via* the Canaries, across the Atlantic to the West Indies at St. Thomas; northward in a nearly direct line to Halifax, *via* Bermuda; southward along the coast to a point off the capes of Delaware to Bermuda, and again across the ocean to Madeira; southward again along the African coast nearly to the equator; westward to St. Paul Rocks and Cape Roque; south and south-east to latitude 40° south; eastward to Tristran da Cunha, the Cape of Good Hope, Marion, the Crozets, Kerguelen, and Heard Island; south to the antarctic ice; north-east to Melbourne and New Zealand; northward to Tongatabu; and westward through the Coral Sea and through the Philippine archipelago, and to Hong Kong. Thence they retraced their way, and, passing north from Papua to Anchorite Island, made a straight wake for Japan; and then eastward across the Pacific to the meridian of 156° west; southward to the Hawaiian Islands, Tahiti, and south latitude 40°; thence eastward to Juan Fernandez and Valparaiso; south, and through Magellan Straits, to the Falklands; and across the Atlantic to the 13th westerly meridian, near which they struck northward to the Cape Verdes, and so home. This course, it will be observed, gave, in the Atlantic, practically four transverse and two axial sections, a complete though rather irregular belt about the southern hemisphere, and an immense rectangle in the Pacific. The opportunities of such a navigation may be better imagined than described; and that they were not neglected, the magnifi-